This thesis deals with the measurement of ultrasonic velocities, densities and viscosities of amino acids and amino sugars to understand the intra and intermolecular interactions between the molecules of components. Excess thermodynamic parameters are calculated for these chosen systems. The study of molecular interactions and the variations in these interactions due to structural changes has been carried out by various experimental techniques. The complete understanding of the nature of intermolecular and intramolecular interaction may not be possible by any single method. A number of workers have reported the study through ultrasonic method [1-14].

The successful application of acoustical methods to physico-chemical investigation of solutions has become possible after the development of adequate theoretical approaches and methods for precise ultrasonic velocity measurements. Few decades ago, many researchers have pointed out that the sound velocity approach for the qualitative estimation of interaction in liquids. A parallel measurement of sound velocity and density of solution allows one to obtain information about their volume, elastic properties and changes in their properties. Complex formation in liquid mixtures has been extensively studied by ultrasonic methods by many workers. The formation of hydrogen bond in solutions and its effect on physical properties of the mixtures have received much attention.
1.1. ULTRASONICS

Ultrasonics is the science of acoustics and the technology of sound. The frequency range of ultrasonic waves is greater than 20 kHz up to several MHz, which is beyond the audible limit. The upper limit for gases is around 5 MHz and for liquids is 500 MHz. Low amplitude waves are more pronounced at frequencies between 2 to 10 MHz. The waves whose frequencies are lower than the audible limit are called infrasonics. But human ears do not respond to either of these frequencies. The ultrasonic technique is used for different investigations due to the following advantages:

- At higher frequencies, the high absorption coefficient values are easily measurable.
- Shorter wavelengths occur at higher frequencies, so that plain wave conditions are more easily realized which is especially important for the smaller specimens.
- Frequencies associated with relaxation phenomena often fall within the ultrasonic range and therefore they can be easily focused.

The study of acoustics had its beginning with the Greek philosopher Pythagoras in 600 BC. He laid the foundation for the use of stringed instruments, which are notable contributions to the science of acoustics. It is believed that Galileo was the first to start the modern studies of acoustics. In 1638, he showed that pitch is associated with vibration, which was considered to be the second milestone in the science of acoustics. He elevated the study of vibration to scientific standards by successful correlation of pitch with frequency of sound.
source. Investigations in high frequency waves did not emerge until 19th century.

The era of modern ultrasonics began only in the early twentieth century with Langevin’s use of high-frequency acoustic waves and quartz resonators for submarine detection in 1917. From then on, slow but steady progress was made in the measurements of propagation constants of materials. Early landmarks included Pierce’s quartz-driven ultrasonic interferometer in 1925 and the discovery in 1932 by Debye and Sears and also by Lucas and Biquard of the ultrasonic diffraction grating. An important event during 1930s was the pioneering work of Sokolov in 1934 on ultrasonic flaw detection.

Ever since, the field has grown enormously with wide applications in science, medicine and other areas. Graff investigated physical, chemical and biological effects of ultrasounds on macromolecules, microorganisms and cells. Stokes made the first attempt in medical imaging using ultrasonics. The explosive rate of development in high frequency digital and computer techniques has opened new avenues for using ultrasonic equipments for laboratory study and industrial purposes. The applications of ultrasonics in various fields such as acoustic microscopy, sono chemistry, drug chemistry, textile industry, paint industry, food and fat industry, flaw detector in metals, polymers, surfactants, binary and ternary liquids, computer technology, under water acoustics, imaging technology in medical diagnosis, electro-chemistry and so on.
1.2. PRODUCTION OF ULTRASONIC WAVES

The devices that generate and detect ultrasonic waves are called transducers. Active transducers or transmitters are those that convert electrical energy into ultrasonic energy and passive transducers or receivers are those, which do the reverse. Transducers use any one of the following techniques: (a) capacitive, (b) magnetostrictive, (c) electrostatic, or (d) piezoelectric devices. The various transducers are listed below:

- Magnetostrictive transducer
- Electromagnetic transducer
- Pneumatic transducer
- Mechanical transducer and
- Piezoelectric transducer

Liquids play an important role in our everyday life. The study of the liquid state properties using spectroscopic and acoustical methods provides valuable information for their varied usage. Acoustics is a field widely used in recent years to study various molecular interactions. Ultrasonics has become a valuable tool in medical and biological sciences, engineering, geophysics, etc. Ultrasonics studies in organic liquids have been the subject of extensive research recently. A study of amino acids and amino sugars holding a position of high relevance and significance in medicine, science and industry, is attempted in the present investigation to elucidate their further role and utilization in all fields in its entirety.

Due to the complex molecular structure of proteins, direct study is tedious and difficult. Therefore, the useful approach is to study simpler
model compounds, such as amino acids which are the building blocks of proteins. As a precursor, the studies on few amino acids [3, 10-13, 15-30] and biomolecules [14] have been carried out in pure aqueous solutions. Here, in this thesis, we wish to report the physico-chemical properties of the following systems, that is, amino acids and amino sugars:

*L-Threonine* is present in the heart, central nervous system and skeletal muscle. It assists in maintaining protein balance in the body and is important in the formation of collagen and elastin. Threonine used to treat indigestion and intestinal malfunctions as well as in preventing excessive liver fat nutrients is more readily absorbed when threonine is present. Good levels of Threonine are found in most meats, dairy and eggs as well as in lower quantities in wheat germ, nuts, beans and some vegetables.

*L-Arginine* stimulate the production of growth hormone, it is very popular for its muscle building and fat burning effect among athletes. Arginine may helps in liver detoxification, maintains immune systems, boost sperm count and support kidney function. Arginine might help slow to more growth by boosting host defenses, aid in cell regeneration and wound healing. Arginine can normalized platelet aggregation in hypercholesterolemia patient and contribute to protein synthesis and break down. It is extremely useful in enhancing the immune system and it increases the size and activity of the thymus gland, which is responsible for manufacturing. The lymphocytes---the much talked about T-cells, which assists the immune system. Arginine found in food sources whole-wheat, nuts seeds, peanuts, brown rice, popcorn, soy, raisins, chocolate, carob.
**L-Cysteine HCl monohydrate** is a sulphur containing non essential amino acid helps to protect our liver and brain from free radical damage cause by alcohol and cigarette smoking cysteine also promote burning of fat and building of muscle mass. It has also found that it may help in strengthening the protective lining of the stomach as well as intestine which may help to prevent damage caused by aspirin and similar drugs. people suffering from HIV/AIDS may benefit from cysteine in proper amounts as low levels are normally reported in people with this problem. Cysteine found in food sources such as poultry, wheat, broccoli, eggs as well as garlic, onion and red peppers.

**L-Methionine** is an essential amino acid that cannot be synthesized in the body, but must be obtained from food sources or from diet supplements. Methionine is important in the formation of blood proteins, globulins and albumins. It also assists in the breakdown of fats, preventing their buildup in the liver and arteries, which can obstruct blood flow to their brain, heart and kidneys.

**L-Lysine mono HCl** assists in calcium absorption and in maintaining nitrogen balance in adults. It is an essential building block for all protein development in children. Among the many functions of lysine is its ability to aid in the production of antibodies, hormones, and enzymes. Because it helps to build muscle protein and repair tissues. Lysine is especially important for those recovering from surgery or sports related injuries. It also lowers triglycerides and has been used in the treatment of migraines. The food sources of lysine are gelatin, chocolate, carrot, coconut, oats, whole wheat and white flour, peanuts, soybeans, and white germ.
**L-Histidine** is one of the 20 most common natural amino acids. It presents in many proteins. **L-Histidine** cannot be formed by other nutrients and must be in the diet to be available to the body. Histidine plays a significant role in the growth and repair tissues, ulcers, hyperacidity, digestics, and gastric juices as well as in the production of red and white blood cells. **L-Histidine** also acts to lower blood pressure and relaxes blood vessels and used to treat various cardiac and circulatory problems.

**L-Isoleucine** is an essential amino acid cannot be manufactured in the body and needs to be supplied in the diet and was first isolated in 1904 from fibrin. Isoleucine promote muscle recovery after physical exercise and on its own it is needed for the formation of hemoglobin as well as assisting with regulation of blood sugar levels as well as eressy levels. It is also involved in blood-clot formation. People involved with strenuous activity under extreme pressure and high attitude may benefit from supplementation of this nutrient. Isoleucine found in fooled sources like almonds, cashews, chicken, egg, fish, lentils, liver, meat etc.

**L-Leucine** is an essential branched chain amino acid that some classify as semi-essential. It is necessary for the optimal growth of infants and for the nitrogen balance in adults. It appears to have no particular therapeutic role, but it is vital in supporting functions. Leucine lowers elevated blood sugar levels and is necessary in promotir the healing of bones, skin and muscle tissue. The L-form of leucine is important in building enzymes and body proteins. Food sources include brown rice, beans, meat, nuts, soy flour and whole wheat.
The amino sugars taken for the present study are as follows:

*N-Acetyl-D-glucosamine* is one of the eight essential sugars needed for ophthalmic health and functioning the human body. It helps in immune system functioning particular in regard to HIV and tumors. *N-Acetyl-D-glucosamine* has been shown to repair the mucosal-lining defensive barrier called the glycosaminoglycan layer (CAG). It helped prevent the flu virus and helps virus from occurring. *N-Acetyl-D-glucosamine* also has a hard in limiting cholesterol absorption and decreasing insulin secretion. *N-Acetyl-D-glucosamine* receptors are found in the thyroid gland, which indicates that it plays role in the transport of thyroglobulin. Concentrated amounts of *N-Acetyl-D-glucosamine* are found in the testes, liver, small intestines, epithelial cells of the endocrine and sebaceous glands, and endothelial cells of blood vessels which indicate involvement in these areas. *N-Acetyl-D-glucosamine* can be found in shark cartilage shiitake mushrooms and in supplements.

*D-Glucosamine HCl* also has anti-inflammation and prevents the creation of enzymes which can damage the cartilage. The main action of glucosamine human body is to stimulate the synthesis of cartilage in joints. *D-Glucosamine HCl* is a small molecule comprised of a sugar molecule, it contains 98% glucosamine and this product is especially good for those with high blood pressure. It has important physiological functions to human as to take part in the detoxification of liver and kidney, to protect liver from inflammation, stimulate the increase of Bifidobiogen in the infant intestines, to treat rheumatoid arthritis and ante-cancer additives and cosmetic.
Of the liquids, water occupies a prominent place as a sustainer of life. Aqueous solutions are gaining vast importance in view of their growing usage. In view of their extensive application, the study of aqueous solutions of amino acids and amino sugars not only makes an academically fascinating exercise but also a fruitful venture.

Using acoustical method, thermodynamic, thermochemical and hydration properties of amino acids and amino sugars taken for the study are determined and analysed at different temperature for various concentrations.

The measurement of ultrasonic velocity helps to evaluate internal pressure and free volume of solutions. The effect of concentration and temperature on internal pressure and free volume are studied and quantitative relationships are established. The dependence of internal pressure and free volume on each other is also verified.

The concept of hydration number is analysed in detail at various temperatures and concentration potentials. Intermolecular interactions are discussed using the thermochemical quantities namely apparent molal volume and apparent molal compressibility.

Various acoustical parameters such as ultrasonic velocity, adiabatic compressibility, specific acoustic impedance, intermolecular free length, acoustical relaxation time, molar sound velocity, molar compressibility, available volume, ultrasonic attenuation and Van der Waal’s constant are estimated. The findings provide a better insight into the molecular environment in solutions.
REFERENCES


